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NOTICE

This Instruction Manual provides general characteristics, operating procedures, theory of operation, maintenance and calibration procedures and includes a complete schematic, troubleshooting guide and parts list pages for the model(s) listed on the front cover.

Any questions concerning this documentation should be directed to the Publications Dept., Trygon Electronics, Inc., 1200 Shames Drive, Westbury, New York, 11590.

Questions concerning the operation and application of Trygon Power Supplies should be directed to the Applications Engineering Department, at the above address.

MEASUREMENT OF REGULATION AND RIPPLE

The specifications cited herein for regulation and ripple can be readily attained on every Trygon Power Supply, provided the proper method of measurement is employed. The major consideration is that the highly stable meter and oscilloscope, specified in the calibration section test procedures, must be connected to the sensing terminals and not the load terminals. The reason for this precaution is that the voltage drop between the load terminals and sensing terminals will yield an inaccurate regulation ripple measurement.

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SECTION 1
DESCRIPTION

1.1 INTRODUCTION

The Silicon Rack Series power supplies are flexible and dependable sources of DC power which can be used to meet a variety of needs ranging in scope from inspection and production testing, to laboratory bench testing and systems applications.

The wide range of outputs available makes these units well suited for use as basic laboratory power sources. The ability to provide power packaged in minimum space with high reliability meets the demands of most systems requirements.

All components used in the construction of the Silicon Rack units are of the highest quality available, and have been subjected to 100% incoming inspection.

Each electrolytic filter capacitor is of computer grade, and has been quoted by the manufacturer as having a life expectancy exceeding ten (10) years. All semiconductors are silicon for high temperature operation, and permit fully reliable operation at ambient temperatures up to 71°C without any derating, addition of heat sinks or forced air cooling. Each power transistor has been generously "derated" and temperature aged to provide high reliability. All rectifiers are hermetically sealed silicon types, and all zener diodes have been temperature stabilized.

1.2 GENERAL FEATURES

Output, Sensing, Remote Voltage Programming and Remote Current Programming terminals are located on terminal boards mounted on the rear panel of the unit. The power switch, power on indicator light, mode indicator light, current and voltage controls and appropriate metering devices are all located on the front panel. For convenience, additional output terminals have been provided on the front panel.

Constant Voltage Mode

A constant voltage is maintained across the output terminals at any preset value from zero to rated voltage output, provided that the load does not draw more than either the rated output current or more than the preset limiting current value determined by the front panel current control settings.

Constant Current Mode

Constant current operation is achieved by maintaining a constant voltage across an internal current sensing resistor. An automatic crossover network changes the mode of operation from Constant Voltage to Constant Current when the current demand reaches that of the preset current adjust control. The

The cross over point is adjustable, and can be established anywhere within the current and voltage range of the unit.

1.2.3 Automatic Current Limiting

Short circuit protection is provided by the Automatic Current Limiting circuit which limits the maximum output current under all load conditions. The point at which automatic current limiting occurs is variable, and may be selected anywhere from 1% of the rated current to the full rated current output of the unit. In the event of a short circuit, the output voltage drops to zero, and returns to normal only when the short circuit is removed.

1.2.4 Mode Indicator

A front panel mode indicator light indicates when the unit is operating in either the constant current or current limiting mode of operation.

1.2.5 Automatic Overvoltage Protection (Optional Feature)

Automatic Overvoltage (OV) Protection is available as an option wherein special circuitry automatically tracks the programmed output voltage and prevents it from exceeding this output voltage. The voltage differential that will cause the OV to trip is approximately 5% or 1.5 volts above the programmed voltage. An internal sensitivity control is provided to desensitize the overvoltage protection circuit.

1.2.6 Remote Programming

Remote Programming is provided in both the voltage and current modes of operation. Both voltage and current may be remotely programmed over their entire ranges. The scale factor for Remote Voltage Programming is 100 ohms per volt. The Remote Current Programming is approximately determined by computing the value of the programming resistor using the formula $R_{PGM} = 100 \left(1 - \frac{\text{LOAD CURRENT}}{\text{RATED CURRENT}}\right)$.

1.3 PRECAUTIONARY MEASURES

1.3.1 Wire Size

To assure proper regulation under all load conditions, and to prevent severe distortions of the AC line voltage, it is very important to take into consideration the physical size and current handling capabilities of the input power line. Serious losses in regulation and an increase in ripple may result from under rated or over loaded AC input lines. The maximum AC impedance from the breaker box to the power supply input should not exceed 0.75Ω's.

1.3.2 Voltage Regulator and Inverter Inputs

Do not use voltage regulators or inverters as a primary power source. The outputs of these devices are usually not sinusoidal in nature, and if used as the AC source for the power supply, will cause serious loss of regulation of the power supply output. Capacitive input filtering used for semiconductor power supplies requires charging to the peak of the rectified AC wave which non-sinusoidal AC sources cannot provide.

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Systems Considerations

In systems applications it is recommended that each power supply input power line be run separately to the AC distribution box, in order to minimize cross coupling and interaction between equipment. Do not run sensitive signal leads such as the remote sensing leads in the same cable as the AC input without shielding. To keep the AC ripple in the output to a minimum, it is recommended that the AC input cables should be run in close proximity to the output load cables.

Terminal Post Resistance

All terminals and shorting links serving Outputs, Sensing and Programming must be securely tightened before use. Serious loss of regulation and an increase in ripple can result due to a voltage drop caused by loose terminals and shorting links.

Variable Transformer Input

If a variable transformer is to be used to test the power supply for low and high AC line operation, it must be able to supply at least twice the VA requirements of the power supply and load.

TRANSISTORIZED POWER SUPPLIES

SILICON RACK SERIES

CONSTANT VOLTAGE/CONSTANT CURRENT

RS Series

OUTPUT: 0-20 VDC/0-40 VDC/0-60 VDC/ 0-160 VDC/0-320 VDC

REGULATION, LINE: 0.01% or 3 mv

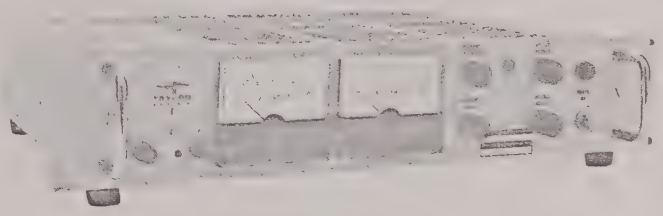
LOAD: 0.01% or 3 mv

RIPPLE: Less than 0.5 mv RMS

INPUT: 105-125 VAC, 55-65 cps

FEATURES

- ALL SILICON DESIGN
- +71°C OPERATION WITHOUT DERATING
- MODE INDICATOR LIGHT
- AUTOMATIC SHORT CIRCUIT PROTECTION
- REMOTE VOLTAGE PROGRAMMING
- REMOTE SENSING
- SERIES OR PARALLEL OPERATION
- NO TURN ON/TURN OFF TRANSIENTS
- OVERVOLTAGE PROTECTION OPTION



ELECTRICAL SPECIFICATIONS

CONSTANT VOLTAGE MODE WITH ADJUSTABLE CURRENT LIMITING

Input: 105-125 VAC, 55-65 cps. (200-240 VAC, 50, or 400 cps available).
Output: Floating; isolated from ground, 300 VDC max.
Regulation, Line: 0.01% or 3 mv,* for 105-125 VAC line change at any output within specifications.
Regulation, Load: 0.01% or 3 mv,* no load to full load at any output within specifications.
Ripple: Less than 0.5 mv RMS.
Stability: 0.05% or 18 mv* for 8 hours after warm-up. Measured at constant line voltage, load and ambient temperature.
Temperature Coefficient: (0.02% + 400μv)/°C.
High Stability Option (X): 0.01% or 2 mv* with a T.C. of (0.01% + 100μv)/°C.
Temperature Range: —20°C to +71°C†.
Recovery Time: 25 microseconds to recover within 0.05% or 15 mv* of output voltage for 100% step change in rated load.
Short Circuit Protection: Automatic Adjustable Current Limiting (ACL) variable from 1% to 100% of rated current.
AC Power Input Protection: Fuse.
Remote Programming: All units remotely programmable over output voltage range. Scale factor approximately 100 ohms/volt.
Remote Sensing: Maintains rated regulation directly at the load. Maximum line drop 0.5 volts per leg.
Voltage Adjustment Range: Continuously adjustable coarse and vernier controls.

CONSTANT CURRENT MODE WITH ADJUSTABLE VOLTAGE LIMITING

Current Range: 1% to rated current output.
Voltage Compliance: 0 to rated output voltage.
Regulation, Line: 0.5% I_{rated} for 105-125 VAC line change at any output within specifications.
Regulation, Load: 0.5% I_{rated} output current change for the maximum change in load resistance within the rated voltage compliance range.
Ripple: 0.25% or 5 ma*.
Stability: 0.5% I_{rated} for 8 hours after warm-up. Measured at constant line voltage, load and ambient temperature.
Temperature Coefficient: 0.1% I_{rated}/°C.
Remote Programming: Fully programmable over complete current range. Programming resistance $R_{pgm} = 100\ (1\text{-}I_{load}/I_{rated})$.

*Whichever is greater.
†When stacked without free air circulation temperature should be limited to +60° C.

TABLE 1

Model	Volts	OUTPUT Amps	*Impedance DC-1KC	DIMENSIONS W	H	D	Weight (lbs.)
RS20-7.5A	0-20	0-7.5	0.002	19	3½	14⅝	42
RS20-15A	0-20	0-15	0.001	19	3½	14⅝	47
RS40-5A	0-40	0-5	0.004	19	3½	14⅝	43
RS40-10A	0-40	0-10	0.002	19	3½	14⅝	45
RS60-7.5A	0-60	0-7.5	0.004	19	3½	14⅝	47
RS160-1A	0-160	0-1	0.008	19	3½	14⅝	45
RS160-3A	0-160	0-3	0.005	19	3½	14⅝	49
RS320-1.5B	0-320	0-1.5	0.020	19	3½	16⅛	49

*Nominal

GENERAL AND PHYSICAL SPECIFICATIONS

Operational Modes: Constant Voltage with adjustable current limiting; Constant Current with adjustable voltage limiting; Automatic Crossover.

Mode Indicator: Front panel mode indicator light indicates when supply is operating in the constant current or current limiting mode.

Controls:
Voltage: Coarse and Fine; 0 to rated output; front panel.
Current: Coarse and Fine; 1% I_{rated} to rated output; front panel.
Input Power: Front panel switch and indicator.

Metering:
Voltage: Front panel voltmeter.
Current: Front panel ammeter.

Terminals:
Front Panel: Pos. Output (+V) — Neg. Output (—V) — Ground (G).
Rear Panel: Pos. Output (+V) — Neg. Output (—V) — Pos. Sensing (+S) — Neg. Sensing (—S) — Ground (G) — Remote Voltage Programming (RVP) — Remote Current Programming (RIP).

Standard Front Panel Paint: Fed. Std. 595, Color Grey 16473.

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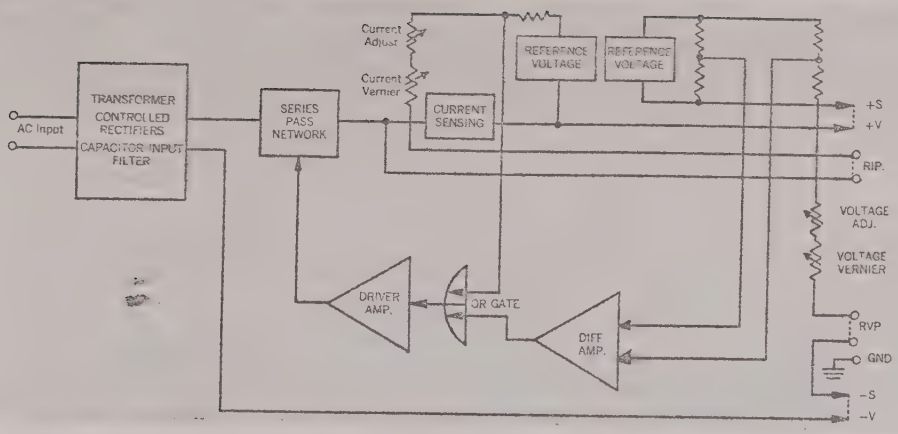


Block Diagram — Silicon Rack Series

DESCRIPTION

• The Trygon SILICON RACK SERIES units are designed for laboratory and systems applicatons. Their unique design provides operating flexibility and high reliability at high power output levels.

• CONSTANT VOLTAGE and CONSTANT CURRENT operation is provided with automatic crossover from one mode into the other. In the voltage mode, adjustable current limiting is provided while the current mode provides adjustable voltage limiting. A mode indicator light on the front panel indicates when the unit is operating in the constant current or current limiting mode. All units in this series have provisions for remote programming of voltage and current.

• MAXIMUM RELIABILITY is achieved through the use of proven design techniques, components selection, and rugged construction. High quality components are used throughout and power transistors are generously derated and temperature aged, zener diodes are temperature stabilized, electrolytic capacitors are computer grade with rated life in excess of 10 years, transformers meet or exceed the requirements of MIL-T-27B, and all Trygon power supplies are manufactured in accordance with the Quality Assurance requirements of MIL-Q-9858. The Silicon Rack Series units carry the Trygon 5 year warranty.

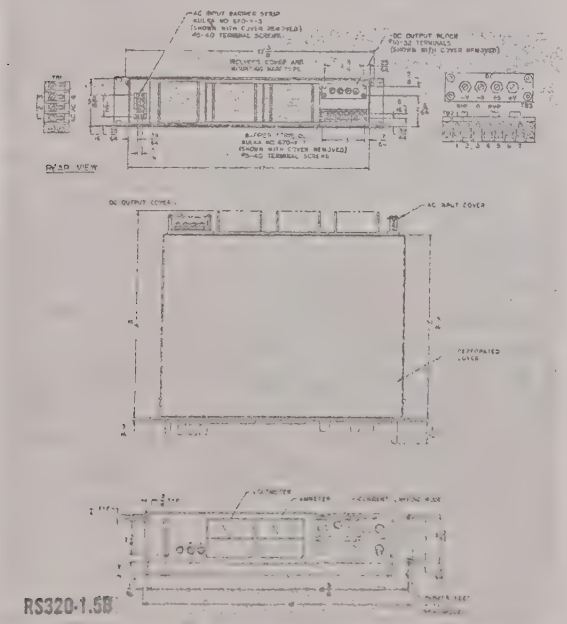
• AUTOMATIC TRACKING OVERVOLTAGE PROTECTION (OV)* is a patented automatic fail-safe overvoltage protection circuit pioneered by Trygon. The OV circuit protects the load against receiving a voltage in excess of the programmed output voltage of the supply. The protection point automatically tracks the programmed output voltage.

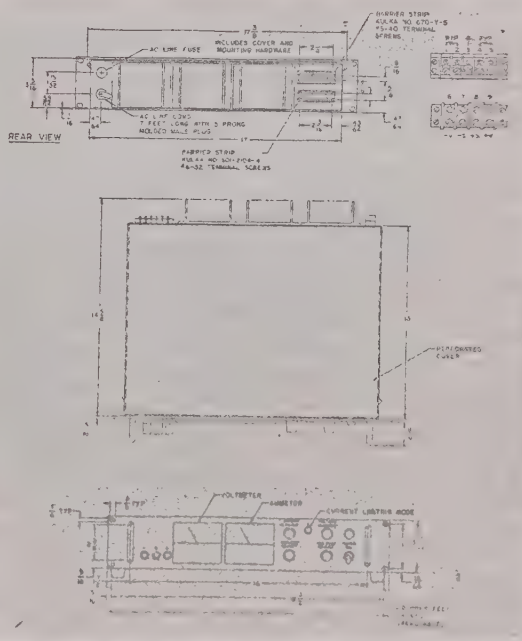
• SERIES OR PARALLEL OPERATION to increase voltage or current can easily be accomplished by connecting two or more supplies of this series together.

• SPECIAL MODIFICATIONS: The standard Silicon Rack RS Series units are available in five voltage ranges. Their outstanding versatility, reliability, and operating convenience make them ideally suited for a large majority of applications in standard form.

• TRYGON ELECTRONICS, INC., has available a number of standard options and modifications to extend even further the range of performance or application of each power supply. In addition, the Trygon Application Engineering department is available for consultation on specific applications.

*Optional





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SECTION 2
INSTALLATION AND OPERATION

2.1 MECHANICAL INSTALLATION

Rack Mounting

Any standard EIA relay rack will accommodate the Trygon Silicon Rack Series power supplies in only 3 1/2 inches of vertical mounting space. Mounting of the unit is easily accomplished by inserting four mounting screws through the slotted holes provided in the four corners of the front panel of the power supply, and on into the matching threaded holes of the relay rack.

Bench Use

Though designed primarily for rack mounting, the Silicon Rack Series power supply may be operated in a bench type configuration as well. It is therefore fully enclosed in a protective metal case, and equipped with rubber mounting feet which serve to protect the unit and the surface upon which it rests from scratching, and to provide an airflow channel under the unit for ventilation purposes.

2.2 ELECTRICAL CONNECTIONS

AC Input

A three terminal barrier strip mounted on the rear panel provides AC input connections to the unit.

The power handling ability of the AC power lines feeding AC power to the unit must be considered, as serious losses in regulation and substantial increases in ripple can occur as a result of insufficient power handling capacity of these lines. The AC impedance from the breaker box to the power supply input connector should not exceed 0.75 ohms. Any movable electric contact surface (such as the wiper arm of a variable transformer) should be kept clear of impedance producing oxide coatings.

Care should be exercised in selecting the proper wire size for the AC input lines. The figures listed in Table 2-1 will serve as a guide in making this selection.

TABLE 2-1 - AC INPUT WIRE SIZE

Length of Run (Single Lead)	Wire Size (AWG Standards)
10 feet or less	14
10 feet to 20 feet	12
20 feet to 50 feet	10
50 feet to 100 feet	8

Rear Panel Barrier Strip

A seven terminal barrier strip mounted on the rear panel provides programming and ground connections. Terminals 1 and 2 provide Remote Current Programming connections, terminals 4 and 5 provide Remote Voltage Programming connections, and terminal 3 is utilized as a ground connection.

DC Output

A heavy duty block containing stud type terminals is provided for DC output and sensing connections. Table 2-2 SHORTING LINK APPLICATION, lists the various shorting link connections required for any of the various modes of operation. Three (3) binding post terminals mounted on the front panel provide output and ground connections. These terminals are primarily for convenience purposes and for easy monitoring of the output.

Local Sensing

Local sensing of the output voltage is made at the rear panel output terminals. The shorting links must be placed across rear panel terminals (-V and -S) and (+V and +S).

Remote Sensing

Remote sensing of the output voltage is available only if the load is connected to the rear panel output terminals. The shorting links between the (-V and -S) and (+V and +S) terminals must be removed and separate sensing leads installed between the sensing terminals (-S and +S) and the load.

Local Programming

Local programming of either current or voltage is available by shorting the appropriate rear panel terminals. For local voltage programming operation, a shorting link should be placed across barrier strip terminals 4 and 5 (RVP). In both local current programming and local voltage programming operation, the output amplitude is dependent upon the setting of the appropriate front panel adjustment control.

Remote Programming

Remote programming of both voltage and current may be achieved by removing the shorting link from the appropriate barrier strip terminals and substituting a remotely operated adjustment control resistance in its place.

In the remote voltage programming mode of operation, the scale factor required for the remotely operated voltage adjustment control is 100 ohms per volt. In order for this remotely operated adjustment control to function properly, the front panel voltage adjustment controls must be set fully CCW. Operation of this power supply without either shorting link or remotely operated adjustment control connected across remote voltage programming barrier strip terminals 4 and 5 (RVP), will result in an unregulated output voltage.

The required size of the remote current programming resistor may be determined by use of the formula $R_{pgm} = 100 (1 - \frac{\text{Load Current}}{\text{Rated Current}})$, where R_{pgm} is the remote program resistor, load current refers to the desired output current, and rated current refers to the maximum output current of the unit. To obtain proper operation of the remotely controlled current adjust control, it is necessary that the front panel current adjustment controls be set fully CW. Operation of this power supply without either shorting link or remotely adjusted current programming control connected across remote current programming barrier strip terminals 1 and 2 (RIP) will result in a complete loss of output current.

Shorting Links

The unit is shipped with shorting links in place across terminals 1 and 2, 4 and 5, -V and -S and +V and +S of the barrier strips. In this configuration, local programming and sensing is available at the barrier strip terminals. Table 2-2 lists the various shorting link connections and their functions.

TABLE 2-2 - SHORTING LINK APPLICATION

Terminals	Condition	Function
-V and -S +V and +S	Shorted Shorted	Local sensing and regulation at rear panel output terminals.
-V and -S +V and +S	Not Connected Not Connected	Remote sensing and regulation at load.
4 and 5	Shorted	Voltage programmed locally, output dependent upon voltage adjust pots.
4 and 5	Ext. PGM res.	Voltage programmed remotely, output dependent upon size of PGM resistor.
1 and 2	Shorted	Current programmed locally, output dependent upon current adjust pots.
1 and 2	Ext. PGM res.	Current programmed remotely, output dependent upon size of PGM resistor.

2.3 CONTROLS

Front Panel

TABLE 2-3 - FRONT PANEL CONTROLS

Name	Function
AC POWER	Power switch, controls input power.
VOLTAGE ADJUST (Coarse)	Potentiometer, adjusts voltage output.
VOLTAGE ADJUST (Vernier)	Potentiometer, adjusts voltage output.
CURRENT ADJUST (Coarse)	Potentiometer, adjusts current.
CURRENT ADJUST (Vernier)	Potentiometer, adjusts current.

Internal

All internal control settings have been factory preset, and require no additional adjusting. However, if it should become necessary to adjust any of the internal controls due to circuit changes caused by component aging or replacement, refer to the calibration section of this instruction manual.

2.4 OPERATION

Control Settings

Set all front panel controls fully CW so that unit will operate in the Voltage rather than Current Limiting mode.

Shorting Links

If Local Sensing rather than Remote Sensing operation is desired, ascertain that shorting links are in place across the appropriate terminals.

Grounding

Either side of the Output may be grounded, or the Output may be used in a floating condition.

Power On

Connect the power supply to a nominal AC power source. Set the Power switch to AC-ON, and observe that pilot lamp DS1 glows.

Warm-Up

No warm-up time is necessary to place the unit into operation. However, a 30 minute warm-up period is recommended to reach rated stability.

Series Operation

To operate two or more power supplies in a series configuration, connect the output of each power supply in series. When operating in this mode, it is necessary to adjust the output of each unit independently. The output voltage is equal to the sum of the voltage settings of each power supply.

Parallel Operation

A) With rated resistive load connected across the output of power supply A as shown in Figure 2-1A set VOLTAGE ADJUST control to desired output voltage, and set CURRENT ADJUST control for maximum rated output current.

B) Connect power supply B as shown in Figure 2-1B With no load across the output, set VOLTAGE ADJUST control for an output voltage 2 volts higher than the output voltage of power supply A. Place a short across the output terminals, and set the CURRENT ADJUST control for 1/2 the total load current requirement.

C) Remove all former output loads and connect the outputs of power supplies A and B in parallel with each other, and in parallel with the load, as shown in Figure 2-2.

D) If parallel operation of these two power supplies is desired for a systems application, it is important that both units be turned on simultaneously. It is therefore recommended that both power supplies be connected to a single large circuit breaker. Maximum output current will be twice that of either of the two power supplies, while minimum output current will be that of power supply B, or half the total load current.

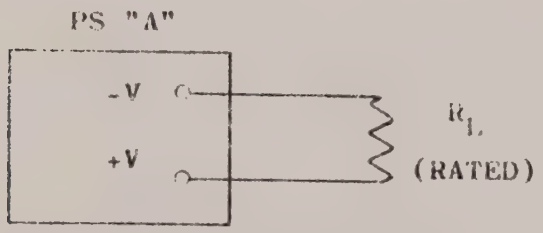

FIGURE 2-1A

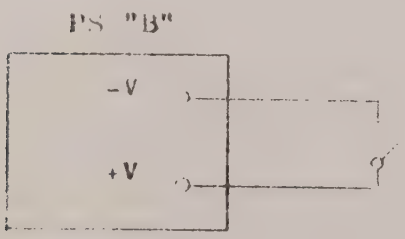

FIGURE 2-1B

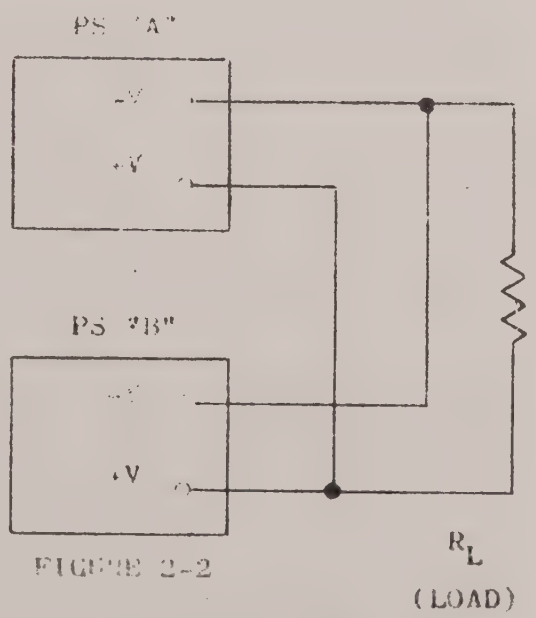

FIGURE 2-2

NOTE: Disconnect the gate lead from the OV SCR in power supply A.

SECTION 3
THEORY OF OPERATION

3.1 GENERAL

The purpose of the Silicon Rack Series power supplies is to transform and rectify the AC input into a well-regulated, stable and adjustable DC output. The following paragraphs describe the major circuits used in the power supplies. As each circuit is described, reference should be made to both the Block Diagram, Figure 3-1 and the Schematic Diagram in the rear of this manual.

Primary Input

Input power is obtained through power transformers T1 and T2 and full wave silicon diode rectifiers. Each pair of rectifiers provide the necessary DC voltages to the various sections of the unit.

When AC power switch S1 is set to AC-ON, AC pilot lamp DS1 glows, and AC power is applied to the power transformers. Regulated DC output power is immediately available from the power supply.

Reference Supply

The rectified and filtered voltage from rectifiers CR1 and CR2 and filter capacitor C1 is pre-regulated by Coarse Reference Regulator zener CR3. This provides a stabilized DC voltage to Constant Current Source Q2, whose output is regulated by Precision Voltage Reference zener CR16. Constant Current Source Q1 controls the drive to Q2 and in turn is controlled by Q2. The voltages developed across Constant Current Source References CR4 and CR16 are highly stable reference voltages established at a higher positive potential than the positive output of the supply.

Pre-Regulator

The purpose of the Pre-Regulator section is to maintain the unregulated input voltage on Input Filter Capacitor C22 at a suitable value compared to the output voltage in order to lower the power dissipation across the Series Pass section of the Series Regulator.

The method used to accomplish this is to "fire" a pair of SCR's (silicon controlled rectifiers), CR27 and CR28, at controlled points along the input sine wave to increase or decrease the potential to which the input filter capacitor may charge. The SCR's are "fired" (allowed to pass current) by the application of a positive pulse at the junction of gating resistors R57 and R58 from amplifier Q11, which amplifies the triggering pulse from unijunction transistor Q13. The unijunction transistor triggers the SCR's when charged sufficiently by timing capacitor C10 to cause conduction. The SCR's are turned off with each alternate half cycle of the input sine wave. Adjustment of R42 is factory set to the optimum full load firing point of the SCR's.

Series Regulator

The pre-regulated DC voltage from the SCR's is directed through the Series Pass transistors. The conduction of these transistors is controlled by circuitry which causes them to act as variable resistors. Their overall resistance varies in accordance with the need of the power supply to increase or decrease its output voltage or current.

The Series Pass transistors are controlled by several driver stages which amplify signals from the error amplifier.

Comparator and Error Amplifier

The voltage sensing and comparison is accomplished by differential amplifier Q10. A sample of the output voltage on the base of Q10 is compared to the stable reference voltage on the base of comparator Q9. An unbalance caused by a change in voltage at either the negative sensing terminal or across voltage adjustment controls R55 and R56 will appear as a voltage change in the collector of Q10.

This difference voltage is amplified by error amplifier Q6, and is used to regulate the Series Pass transistors via the Series Pass drivers. Error amplifier Q6 has two diode inputs to its base which form an OR gate for error signals. CR7 supplies error signals from the comparator, and CR6 supplies an error signal in the event of a short circuit, or if the power supply is driven into the current limiting mode of operation.

When operating in the current limiting mode, differential amplifier Q3 and Q4 become balanced, causing diode CR6 to conduct, and in turn drives error amplifier Q6 toward cut-off. This signal also causes Q7 to conduct, thereby causing current mode indicator lamp DS2 to glow.

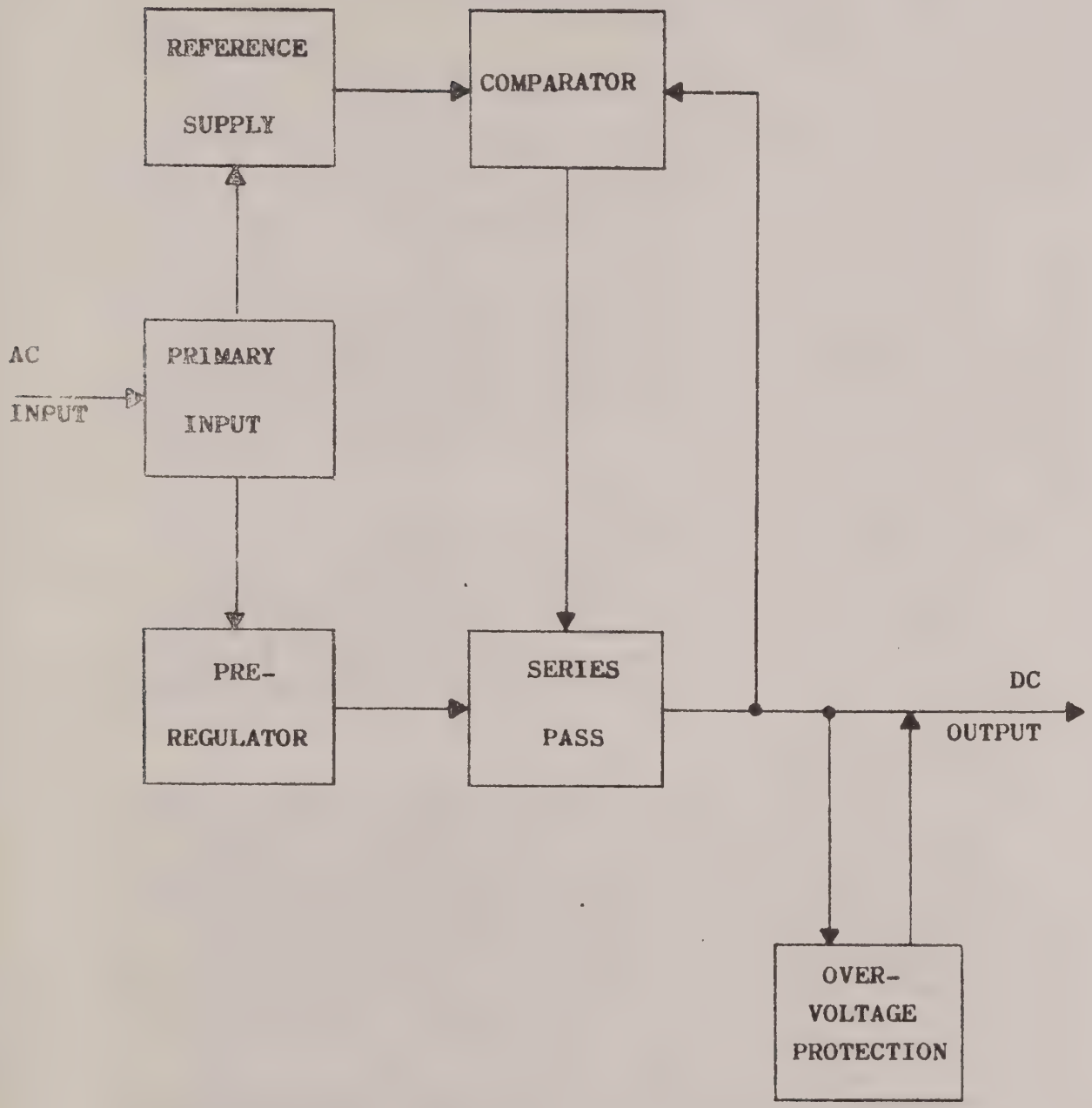

FIGURE 3-1 - BLOCK DIAGRAM

SECTION 4

MAINTENANCE

- WARNING -

High Voltages Are Present
Use Caution

4.1 GENERAL

This power supply is a precision instrument. It is strongly recommended that only experienced trouble shooting personnel perform trouble shooting operations or attempt to repair the unit. If the power supply appears to be malfunctioning at all, the following procedure is recommended for isolating possible defects.

4.2 LOADS AND INTERCONNECTIONS

1) Disconnect all loads and interconnections.

2) Connect a resistive load across the output terminals, and operate the unit to determine whether the fault lies within the unit or externally. Observe that shorting links are in place across terminals 1 and 2, 4 and 5, -V and -S and +V and +S, and that all connections are tightly made.

4.3 TROUBLESHOOTING

1) Set the VOLTAGE ADJUST controls fully CW. Use a 20,000 ohms per volt voltmeter or oscilloscope to check the voltages across the various circuit components listed in the Troubleshooting Guide located in the rear of the manual. Any reading which is grossly incorrect indicates that the stage being tested or the one immediately preceding it, is defective. The Block Diagram, Schematic Diagram and appropriate sections of the Theory of Operation will prove helpful in any troubleshooting work. Proper polarity to be observed when testing can be easily obtained from the Schematic Diagram.

2) If voltage checks show no noticeable deviations from the prescribed values, disconnect AC power and proceed with point to point resistance checks across pots, switches, diodes, resistors, transistors, in that order.

3) When the trouble is of an intermittent nature such as poor regulation, ripple, etc., the use of an oscilloscope to determine dynamic changes will be necessary.

SECTION 5
CALIBRATION

5.1 GENERAL

The following adjustments should be made when necessary to assure optimum operating characteristics and maximum efficiency of the Trygon power supply.

5.2 TEST EQUIPMENT REQUIRED (or equivalent)

A) Oscilloscope, Tektronix Type 561
B) Differential Amplifier Plug In, Tektronix Type 63
C) Time Base Plug In, Tektronix Type 67
D) Differential VTVM, Fluke Model 825A
E) AC VTVM, Hewlett Packard Model 400D
F) VOM, Simpson Model 260
G) Variable Auto transformer, Powerstat Type 3PN136 (20 Ampere rating)

Shorting Link Application

For test purposes, shorting links should be connected across terminals 1 and 2, 4 and 5, -V and -S and +V and +S, to provide local sensing and local programming. To reduce pick up, shielded wire must be used for all connections between test equipment and the power supply being tested. To prevent ground loops, it is important that only one ground connection be made, as shown in Figure 5-1 and Figure 5-2. Tighten all terminal connections as securely as possible, and set all front panel controls fully CW.

5.3 CALIBRATION PROCEDURE

Pre-Regulator

A) With power supply operating without a resistive load across the output terminals, vary the VOLTAGE ADJUST controls until 100% of rated voltage output is indicated on the DC voltmeter. Set the AC POWER switch to OFF, and connect a resistive load across the output terminals. Set the AC POWER switch back to ON, and adjust the resistive load for rated current setting on ammeter.

B) Set oscilloscope to DC triggering mode and connect scope input across the positive terminals of input capacitor C22 and output capacitor C14.

C) Adjust Pre-Regulator Input Balance control **R29** for a balanced 120 Hz sawtooth shaped waveform.

D) Adjust Series Pass Voltage control **R42** for approximately 10 VDC, measured between the positive terminals of input capacitor C22 and output capacitor C14.

E) Vary AC input voltage 10% above and below the nominal input level. Observe that the voltage measured between the positive terminals of the input and output capacitors, does not vary by more than 20%, at either input voltage extreme.

Voltage Adjust Control

A) Maximum Voltage

Set front panel VOLTAGE ADJUST and VOLTAGE VERNIER controls fully CW. Adjust Maximum Voltage control R24 to obtain an output voltage 0.5 VDC in excess of the maximum rated output voltage.

B) Minimum Voltage

Set front panel VOLTAGE ADJUST and VOLTAGE VERNIER controls fully CCW. Adjust Minimum Voltage control R27 to obtain a negative output voltage of 0.2 VDC.

C) Readjustment

Adjustment of either Maximum Voltage control R24 or Minimum Voltage control R27 will have an effect upon the other. Therefore, these controls should be readjusted if necessary, as outlined in above paragraphs (A) and (B), upon initial completion of this adjustment.

NOTE

If partial rotation of the VOLTAGE ADJUST controls produces no apparent change in indicated output voltage, further rotation of these controls should not be attempted. Rotation of these controls fully CCW with little or no output voltage regulation can result in damage to the controls, the load, or both. Set the AC POWER switch to OFF, and proceed with the troubleshooting outlined in Section 4 (MAINTENANCE) of this instruction manual.

Set front panel VOLTAGE ADJUST and VOLTAGE VERNIER controls fully CCW and observe that the voltage indicated on the unit and test voltmeters drops slightly below the zero setting of the meters. The output voltage should be approximately negative 200 mv. Reset voltage controls fully CW.

Current Adjust Controls

A) Maximum Current

Connect a test ammeter having a full scale current indicating capacity of 150% that of the rated current output across the output terminals of the power supply. (Set all front panel controls fully CCW.) Apply power to the unit under test and slowly rotate CURRENT VERNIER control fully CW. Observe that the maximum current obtainable is approximately 110% that of the maximum rated current output. If it is not possible to achieve 110% of the maximum rated current output, adjust Maximum Current control R72

until that value is attained. Set AC Power Switch to OFF.

Connect a suitable load resistance across the output terminal connections. The load resistance must be able to dissipate the rated power of the unit (P = IE) and must be of sufficient value to yield the rated output current when the rated voltage is applied. Set AC Power Switch to ON. Note the voltage indicated on the Differential VTVM. Disconnect the resistive load from the output and observe the voltage indicated on the Differential VTVM. The maximum change in output voltage should not exceed by more than 0.01% or 3mv (whichever is greater) that of the output voltage indicated with the load resistance applied across the output terminals.

If it is not possible to maintain the load regulation as stated in the preceding paragraph, readjust Maximum Current control R72 slightly and recheck the load regulation.

B) Minimum Current

Connect test ammeter, having a full-scale current indicating capacity of 100 ma, across output terminals in place of a load resistor. Set all front panel controls fully CCW and apply power to the unit under test. Slowly rotate VOLTAGE ADJUST control in a CW direction, until current meter indicates a current flow somewhere between 0-50ma. Adjust Minimum Current control R80 for a nominal current indication of 1% of the rated current. Set the POWER ON switch to OFF.

Constant Voltage Operation

A) Load Regulation

With the equipment connected as shown in Figure 5-1, connect a suitable load resistance across the Output terminal connections. The load resistance selected must be able to dissipate the rated power of the unit (P = IE) and must be of sufficient value to yield the rated output current when the rated voltage is applied. Note the voltage indicated on the Differential VTVM. Disconnect the resistive load from the output. The maximum change in output DC voltage indicated on the Differential VTVM should not exceed by more than 0.01% or 3mv (whichever is greater) that of the output voltage indicated with the load resistance applied across the output terminals.

B) Line Regulation

Place the resistive load across the output and note the voltage indicated on the Differential VTVM. (Vary the input line voltage ± 10 percent. The maximum change in output voltage should not exceed by more than 0.01% or 3mv (whichever is greater) that of the output voltage measured at either extreme of the AC input.

C) Ripple Voltage

In order to reduce pickup, shielded test leads should be used in making ripple measurements. With the resistive load connected across the output terminals, measure the AC ripple with the AC VTVM. Vary the AC input power 10% above and below the nominal AC input level. The maximum ripple amplitude should not exceed 0.5 mv RMS.

Constant Current Operation

A) Load Regulation

With the equipment turned off, disconnect the resistive load from the output terminals. Connect a small current sensing resistor in series with the resistive load and then connect the load back across the output terminals. Selection of the proper value for the current sensing resistor may be easily made using the formula $R_S = \frac{I}{I_R}$ where R_S = Value of Current Sensing Resistor and I_R = Rated Load Current. Connect the equipment as shown in Figure 5-2, and apply power to the power supply.

Vary the VOLTAGE ADJUST controls and resistive output load as necessary, to achieve rated current and voltage output. Decrease the load resistance until current meter reading exceeds full scale indication. Rotate CURRENT ADJUST control CCW to return the current meter reading to full scale. Observe that the output voltage has decreased from its previous full scale reading, and that increasing the VOLTAGE ADJUST controls has no effect upon the output voltage or current. This indicates that the unit is now operating in the Constant Current Mode.

Measure the voltage across the small sensing resistor. Compute and note the current flow through this resistor. Change the output load from the resistive load previously used, to a short. Again measure the voltage across the small sensing resistor and compute the value of the current flow through this resistor. The change in current should not exceed by more than 0.5% the rated current previously noted with a full resistive load across the output.

B) Line Regulation

Replace the resistive load across the output and measure the voltage drop across the small sensing resistor. Compute and note the current flow ($I = \frac{E}{R}$) through this resistor.

Vary the input line voltage ± 10 percent.
Note the maximum change in voltage across the sensing resistor and compute the maximum current flow. The maximum change in current should not exceed by more than 0.5% the rated current previously noted at either extreme of the AC input.

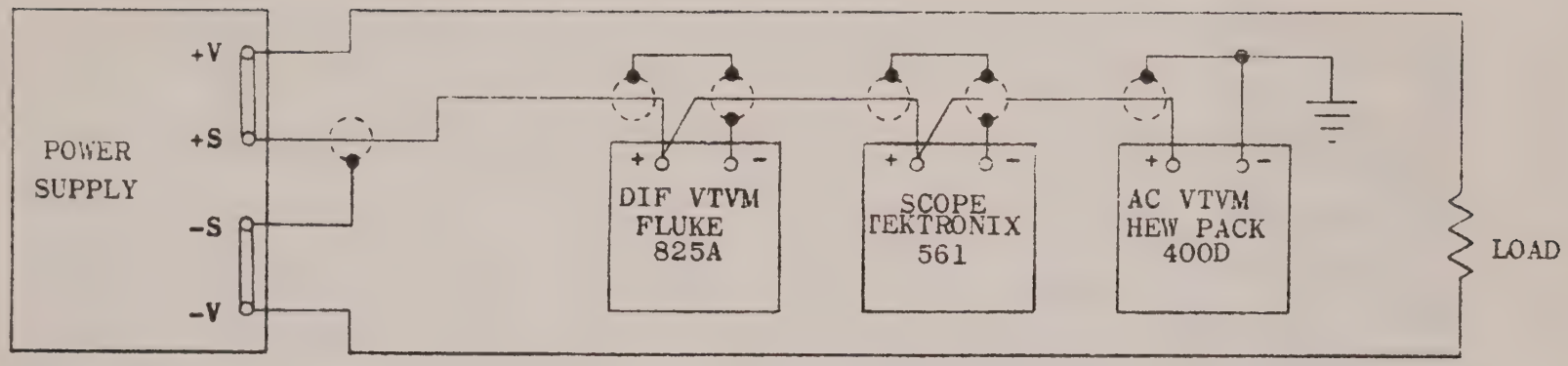

FIGURE 5-1
CONSTANT VOLTAGE OPERATION

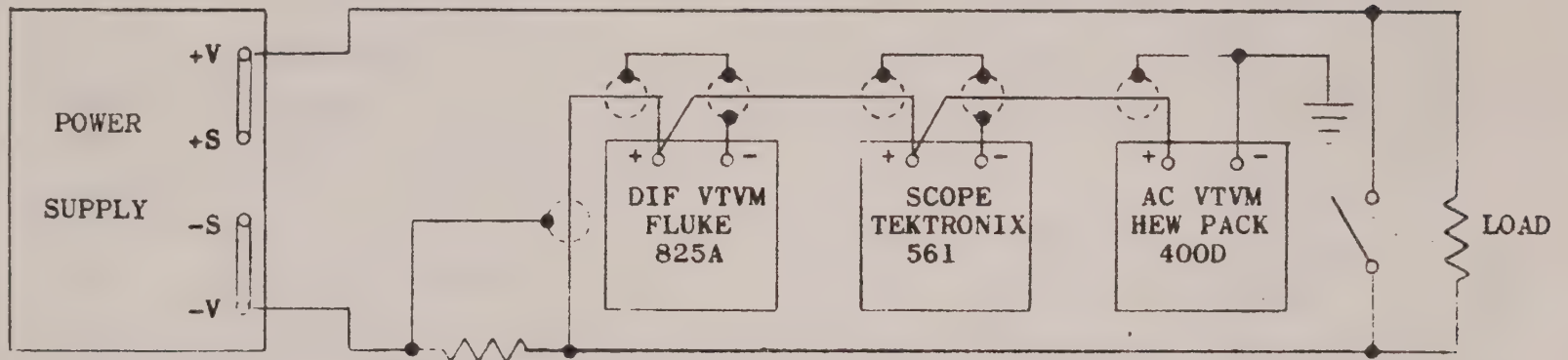

FIGURE 5-2
CONSTANT CURRENT OPERATION

C) Ripple Current

With the AC input line voltage adjusted to the nominal AC input voltage and the resistive load connected across the output, measure the amplitude of the AC ripple as seen across the sensing resistor with the AC VTVM. Compute and note the current flow. Vary the AC input line voltage ± 10 percent. Measure the maximum voltage drop and compute the maximum current flow. The maximum ripple current must not exceed by more than 0.25% or 5 ma (whichever is greater) that of the current flow noted during nominal input line voltage.

1) The numbers designated in the SPARES column of the following ELECTRICAL PARTS LISTING indicate the recommended spare parts requirement for support of this equipment for a period of one year.

2) The code designations listed in the MFR column of the ELECTRICAL PARTS LISTING have been assigned to the following manufacturers:

CODE	MANUFACTURER
A-B	ALLEN BRADLEY
ARN	ARNOLD
BUSS	BUSS
CARL	CARLING
CD	CORNELL DUBILIER
CLAR	CLAROSTAT
CORN	CORNISH
CTS	CHICAGO TELEPHONE SUPPLY
ERIE	ERIE
GE	GENERAL ELECTRIC
GI	GENERAL INSTRUMENTS
HOYT	HOYT
IREC	INTERNATIONAL RECTIFIER CORP.
IRES	INTERNATIONAL RESISTOR CORP.
OHM	OHMITE
SCHW	SCHWEBER

CODE	MANUFACTURER
LEE	LEECRAFT
MILW	MILWAUKEE
MOTO	MOTOROLA
PHAO	PHAOSTRON
RCA	RADIO CORPORATION OF AMERICA
ROT	ROTRON
SAGE	SAGE
SANG	SANGAMO
SPRA	SPRAGUE
STEV	STEVENS
TRAN	TRANSITRON
TRY	TRYGON
UNI	UNITRODE
WILG	WILGREEN
WL	WARD LEONARD
SEMC	SEMCOR

Semi-conductors commonly used in Trygon Power Supplies are available for replacement or spare parts use under the following Trygon, commercial manufacturer or JEDEC part number.

TRANSISTORS

SEMI-CONDUCTOR PART NUMBERS

TRYGON STOCK NO.	TRYGON or MFR P/N	JEDEC EQUIVALENT
700000	See 705067	
700001	See 700002	
700002	700002	2N3638A
700010	TR346	2N1556
700020	See 705067	
700030	TR361	2N652
700040	TR375	2N1533
700047	700047	2N4238
700050	700050	2N657A
700070	TR951	2N2527
700080	700080	2N3055
700083	700083	2N3232
700085	700085	2N3442
700115	See 705067	
700120	700120	2N1530
700130	700130	2N1554
700140	700140	2N1560
700160	700160	2N2140
700180	700180	2N2714
700182	700182	2N3566
700191	700191	2N4912
700195	700195	2N3441
700196	700196	2N4912
700197	700197	2N3738
700200	700200	2N2139
700205	700205	2N3440
700400	700400	2N3441
700401	700401	2N3771
700402	700402	2N3772
700410	700410	2N3442
700412	700412	2N3568
700413	700413	2N3644
700415	700415	2N3585
700417	700417	2N4918
700420	700420	2N3584
700429	DTS411	DTS411
700430	DTS413	DTS413
700431	DTS423	DTS423
700502	700502	2N5037
700508	700508	2N5240
705018	705018	2N3416
705067	705067	2N2905A
705068	705068	2N2219A
705069	705069	2N4340
705070	705070	2N3233
705071	705071	2N3447
720145	UJ25	2N2647

Semi-conductors commonly used in Trygon power supplies are available for replacement of spare parts use under the following Trygon, commercial manufacturer of JEDEC part number.

RECTIFIERS

SEMI-CONDUCTOR PART NUMBERS

TRYGON STOCK NO.	TRYGON or MFR P/N	JEDEC EQUIVALENT
705014	705014	2N1929
720000	C35B	2N685
720005	C33F	
720010	C35F	2N682
720015	C30F	
720030	C50AX258	
720040	C50B	2N1913
720043	C50C	2N1915
720050	C50F	2N1910
720053	C60A	2N2025
720060	E016	
720075	E0130	
720110	SV515	IN823
720131	720131	IN3618
720132	720132	IN3616
720133	720133	IN3619
720135	720135	IN3495R
720136	720136	IN3621
720137	720137	IN3622
720173	IN759A	IN5242B
720175	IN746A	IN5226B
720181	IN751A	IN5231B
720182	IN754A	IN5235B
720185	IN752A	IN5232B
720192	IN753A	IN5234B
720196	IN755A	IN5236B
720241	IN1360A	IN2986A
720262	IN2163A	IN2163A
720263	IN2163A	IN2163A
720273	SCR285-2	
720274	SCR285-3	
720275	SCR285-4	
720277	SCR285-5	
720280	SCR93-2	
720290	SCR93-3	2N2573
720300	SCR93-4	2N2574
720301	SCR93-5	2N2677
720303	SCR93-7	
720330	70H10	
720335	40HF10	1N1184A
720350	70H20	1N4130
720383	IN4585	1N4585
720384	1N4384	1N4384
720387	1N4740A	1N4740A
720388	1N4733A	1N4733A
720394	1N964B	1N5243B
720395	1N965B	1N5245B

Semi-conductors commonly used in Trygon power supplies are available for replacement of spare parts use under the following Trygon, commercial manufacturer or JEDEC part number

RECTIFIERS

SEMI-CONDUCTOR PART NUMBERS

TRYGON STOCK NO.	TRYGON or MFR P/N	JEDEC EQUIVALENT
720427	See 720136	
720440	TR4148	1N148
720443		1N3208
720450	See 720456	1N3659
720453	See 720456	1N4719
720454	MR1031A	1N4720
720455	MR1032A	1N4721
720456	MR1034A	1N4722
720458	See 720456	
720459	1N758	1N758
720397	1N2164A	1N2164A
720460	1N961B	1N5240B
720468	1N968	1N5250B
720473	1N821	1N821
720488	60HF60	1N2138
720489	C46E	
725008	C180A	
725019	1N765A	1N5241B
725056	MR1220SL	
725071	1N3515A	1N5236B
725076	1N3616	1N3616
725077		1N3262R
725079	MCR2835-4	
725081	MCR216R-2	
725082	MCR216R-3	
725083	MCR216R-5	
725085	MCR216R-6	
725087	MCR3918-1	2N5168
725138	725138	2N4441
725139	See 725142	
725140	MAC 3-2	
725142	725142	2N4442
725143	Y0525	
725144	40526	
741001	741001	2N4990

B/M CHANGES DATE PAGE

PART NO	DESCRIPTION					B/M NO	S/A	QTY
00000	RS320 185					40900	00	1
								1
00000	FRONT PANEL ASSY RS320 185					40900	021	1
049268	COVER SUPPORT					40900	021	1
076278	FRONT PANEL				0	40900	021	1
600010	POT 10 2 W10 B281					40900	021	1
	R 78							
600059	POT 100 2W B6132					40900	021	1
	R 77							
600100	POT 250 2 W10 B164					40900	021	1
	R 55							
600372	POT 50K 4W 10 A7377					40900	021	1
	R 56							
752096	METER 350V AP2					40900	021	1
	M 001							
754012	METER 1.5A EXT AP 2					40900	021	1
	M 002							
770020	PILOT LIGHT 55RH F2 R1 NISL					40900	021	1
	DS 01							
770023	LIGHT IND 41N G6 1317 985T					40900	021	1
	DS 02							
800254	CAP.22F400V METAL MYLAR					40900	021	1
	C 030							
840200	HOLDER FUSE 342004					40900	021	1
	F 01							
880030	SWITCH DPST NST52K					40900	021	1
	S 01							
920040	HANDLE 5476					40900	021	2
920100	KNOB NO INSERT RB700					40900	021	4
920150	POST BINDING BLACK DF21BC					40900	021	1
920160	POST BINDING RED DF21RC					40900	021	1
920170	POST BINDING WHITE DF21WTC					40900	021	1
								23
00000	CHASSIS ASSY RS 320 185					40900	101	1
046598	CLAMP CAPACITOR					40900	101	2
076068	BRACKET B76060					40900	101	2
076248	CHASSIS				0	40900	101	1
076358	BRACKET RESISTOR B76350					40900	101	2
076368	CAP CLAMP SMALL B76360					40900	101	2
505575	XFORMER RT 320 185 1					40900	101	1
505578	XFORMER RT 320 185 2					40900	101	1
650095	RWW 867 25W 20					40900	101	1
	P 76							
650570	RWW 150 25 W 20					40900	101	1
	R 01							
650804	RWW 5K 50W 5 40					40900	101	1
	R 59							
650818	RWW 15K 50W 5%					40900	101	1
	R 082							
800295	CAP .47MF 400V C 23					40900	101	1
820027	CAP 90MF 400V 85F2325 BA					40900	101	1
	C 29							
820036	CAP 750MF 350V 86F2285 EE					40900	101	1

PART NO	DESCRIPTION			BM NO	S/A	QTY
	C 14					
820050	CAP 950MF 50V	500 1154 03		40900	101	1
	C 01					
820138	CAP 2200MF 400V	86F2395 GH		40900	101	1
	C 22					
900070	BRACKET CAP	06		40900	101	2
900130	BRACKET	80031P4		40900	101	2
942029	CABLE HARNESS AC			40900	101	1
942030	CABLE HARNESS DC			40900	101	1
						27
076268	COVER		0	40900	108	1
						1
840217	LINK SHORTING			40900	109	3
						3
00000	DIODE BKT ASSY	RS 320 185		40900	111	1
076348	DIODE BRACKET		C76340	40900	111	1
720137	DIODE 12 AMP 600V			40900	111	1
	CR032					
720241	ZENER DIODE	IN 1360A	0	40900	111	1
	CR003					
						4
00000	REAR PLATE ASSY	RS320 185		40900	121	1
012240	LINK SHORTING			40900	121	2
076258	REAR PLATE		0	40900	121	1
076460	OUTPUT BLOCK		B76460	40900	121	1
	TB 03					
503001	CHOKE ASSY			40900	121	1
800254	CAP .22MF 400V			40900	121	1
	C 020					
851103	STRIP BARRIER	670Y 3		40900	121	1
	TB 01					
851107	STRIP BARRIER 670Y 7			40900	121	1
	TB 02					
860100	STANDOFF SLG			40900	121	2
860130	STANDOFF ILG			40900	121	2
971005	ROD THREADED 10 32			40900	121	4
						17
077048	COVER BARRIER			40900	128	1
077058	COVER DC			40900	128	1
						2
840216	LINK SHORTING 601J			40900	129	3
						3
00000	COMP BD ASSY	RS320 185		40900	133	1
076438	COMP BOARD		C76430	40900	133	1
600071	POT 150 1.5W 110			40900	133	3
	R 024027072					
600204	POT 2K 185 W20 110		0	40900	133	1
	R 80					

PART NO	DESCRIPTION	BM NO	S/A	QTY
600364	POT 25Ω K 825W10 UPE2000	40900	133	2
	R 42 44			
610030	RCOMP 47Ω 85 W10 RC2	40900	133	2
	R 57 58			
610070	RCOMP 100Ω 85 W10 RC2	40900	133	2
	R 08 28			
610080	RCOMP 150Ω 85 W10 RC2	40900	133	2
	R 036037			
610120	RCOMP 330 85W	40900	133	2
	R 013041			
610140	RCOMP 470Ω 85 W10 RC2	40900	133	1
	R 11			
610150	RCOMP 560Ω 85 W10 RC2	40900	133	1
	R 16			
610180	R COMP 1K 85W	40900	133	3
	R 061063067			
610210	RCOMP 2.2K 85W	40900	133	2
	R 038068			
610250	RCOMP 4.7 K 85 W10 RC20	40900	133	1
	R 12			
610290	RCOMP 10Ω K 85 W10 RC2	40900	133	1
	R 14			
610300	RCOMP 15Ω K 85 W10 RC2	40900	133	1
	R 54			
611055	RCOMP 1.85M 85W 10 RC20	40900	133	1
	R 47			
620030	RMF 100 85 W 1 CECT	40900	133	1
	R 70			
620110	RMF 301 .5W 1	40900	133	2
	R 071079			
620140	RMF 402 85 W 1 CECT	40900	133	1
	R 17			
620195	RMF 562 .5W 1	40900	133	1
	R 022			
620210	RMF 604 85 W 1 CECT	40900	133	1
	R 75			
620220	RMF 681 5W 1%	40900	133	1
	R 039			
620250	RMF 750 85 W 1 CECT	40900	133	2
	R 09 23			
620320	RMF 1.18K 85 W 1 CECT	40900	133	1
	R 04			
620402	RMF 1.96 K 85 W 1 CECT	40900	133	7
	R 06 07 10 20 21			
	R 73 74			
620467	RMF 2.95 K 85 W 85 CECT	40900	133	1
	R 40			
620580	RMF 4.99 K 85 W 1 CECT	40900	133	3
	R 43 45 46			
620610	RMF 6.08 K 85 W 2 RL20	40900	133	1
	R 02			
620710	RMF 0499.2 K 85 W 8 CECTO	40900	133	1
	R 03			
620754	RMF 75K .5W 1%	40900	133	1
	R 015			

PART NO	DESCRIPTION	BM NO	S/A	UQTY
630250	RLTC 100 3W 3	40900	133	1
	R 025			
630255	RLTC 130 3W 3	40900	133	1
	R 026			
630261	RESISTOR 170 1	40900	133	1
	R 005			
630372	RLTC 750 1W 3 1000S 0	40900	133	1
	R 19			
630375	RLTC 7503 W 3	40900	133	1
	R 084			
630418	RLTC 125K 1W 3 1000S	40900	133	1
	R 18			
630460	RLTC 38 K 38 W 38 1300	40900	133	2
	R 32 34			
640325	RWW 828 28 W108 8W	40900	133	1
	R 35			
640500	RWW 1 K 2 W10 BWH	40900	133	1
	R 33			
640549	RWW 4K 5W 5 5X	40900	133	1
	R 64			
640551	RWW 5K 5W 5 5X	40900	133	1
	R 062			
~~700008~~	~~TRANSISTOR TR 1132~~ 2N2905A	40900	133	4
705067	Q 02 06 12 14			
700047	2N 4238	40900	133	1
	Q 011			
~~700110~~	~~TRANSISTOR TR 2195~~ 2N2219A	40900	133	2
705068	Q 01 20			
~~700180~~	~~TRANSISTOR 16 A507~~	40900	133	8
	Q 03 04 05 07 08			
	Q 09 10 21			
720145	UNIJUNCTION UJ25 4JX5E600	40900	133	1
	Q 13			
720181	DIODE ZENER IN 751A	40900	133	2
	CR004031			
720384	DIODE ZENER IN4384 0	40900	133	13
	CR 05 06 07 08 15			
	CR 18 19 20 23 24			
	CR 30 33 42			
720394	DIODE ZENER IN9648 0	40900	133	1
	CR 17			
720397	DIODE ZENER IN 2164A 0	40900	133	1
	CR 16			
800006	CAP .001MF 600V CK628X102M	40900	133	2
	C 05 24			
800025	CAP .0033MF 600V CK62AW332	40900	133	1
	C 04			
800050	CAP .0047MF 600V	40900	133	1
	C 031			
800090	CAP .01 MF 600V 811Z5V103P	40900	133	1
	C 06			
800147	CAP .047 250V	40900	133	1
	C 02			
800185	CAP 1MF 250V	40900	133	2
	C 007010			

PART NO	DESCRIPTION		BM NO	S/A	QTY
800254	CAP .22 MF 400V METAL MYLAR		40900	133	1
	C D17				
810010	CAP 10MF 50V TTXE		40900	133	1
	C 08				
810090	CAP 75MF 15V 4007S6F015DD4		40900	133	1
	C 09				
					107
00000	HEAT SINK ASSY RS320 185		40900	141	1
076318	HEAT SINK DIODE SCR	0	40900	141	1
720137	DIODE IN1206A-IN3622		40900	141	2
	CR D25 D26				
725130	SCR 2N3670		40900	141	2
	CR 27 28				
					6
00000	COMP BD ASSY RS 320 185		40900	143	1
076448	COMP BOARD C7644		40900	143	1
600290	POT S K 185 W20 110	0	40900	143	1
	R 29				
610600	RCOMP 330 K 85 W10S RC20		40900	143	1
	R 31				
611135	RCOMP 487M 85 W10 RC20		40900	143	1
	R 30				
720383	DIODE ZENER IN 4585		40900	143	4
	CR D38 D39 D40 D41				
720384	DIODE ZENER IN4384	0	40900	143	8
	CR 09 10 11 12 13				
	CR 14 36 37				
810161	CAP 210MF 25V 600D217G025DJ4		40900	143	1
	C D27				
					18
830070	SOCKET TRANSIST PTS 1		40900	149	2
990290	WASHER MICA		40900	149	2
					4
00000	HEAT SINK ASSY RS320 185		40900	151	1
076328	HEAT SINK XISTOR LARGE C76320		40900	151	1
630020	RLTC &7 38 W 38 1300		40900	151	1
	R 66				
700431	TRANS DTS 423		40900	151	1
	Q D16				
					4
00000	COMP BD ASSY RS320 185		40900	153	1
076450	COMP BOARD C76450		40900	153	1
610070	RCOMP 100S 85 W10S RC2		40900	153	2
	R 51 53				
620677	RMF 3061 K 85 W 1 CECTO		40900	153	1
	R 52				
620800	RMF 100S K 85 W 1P CECT		40900	153	2
	R 48 49				
690650	RWW 30K 5W S 5%		40900	153	1
	R 52				

610012 - RCOMP 22 - .5W - 10% - 153 - 1
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PART NO	DESCRIPTION		BM NO	S/A	QTY
720383	DIODE ZENER IN 4585		40900	153	2
	CR021022				
720384	DIODE ZENER IN4384	0	40900	153	2
	CR 01 02				
720468	DIODE ZENER IN 968		40900	153	1
	CR 29				
800254	CAP 822 MF 400V METAL MYLAR		40900	153	1
	C 11				
800295	CAP 847 MF 400V METAL MYLA		40900	153	1
	C 12				
810060	CAP 35MF 25V 400356FD25DD4		40900	153	1
	C 13				
860110	STANDOFF 8750LG 8218 B 06320		40900	153	4
					20
830070	SOCKET TRANSIST PTS 1		40900	159	1
860020	STANDOFF TERMINAL 2304	0	40900	159	1
990290	WASHER MICA		40900	159	1
					3
00000	HEAT SINK ASSY RS 320 185		40900	161	1
076338	HEAT SINK XISTOR SMALL C76330		40900	161	1
630020	RLTC 87 38 W 38 1300		40900	161	1
	R 65				
700191	TRANSISTOR TR1591		40900	161	1
	Q 18				
700431	TRANSISTOR DTS 423	0	40900	161	1
	Q 15				
					5
830070	SOCKET TRANSIST PTS 1		40900	169	1
830075	SOCKET TRANSISTOR PTS 4	0	40900	169	1
860020	STANDOFF TERMINAL 2304	0	40900	169	1
990285	WASHER MICA FOR TR1590		40900	169	1
990290	WASHER MICA		40900	169	1
					5
000000	SHUNT BOARD ASSY		40900	173	1
079408	BOARD METER SHUNT RS320 15		40900	173	1
600070	POT 150 1.5W 20		40900	173	1
	R 090				
620676	RMF 29.95K.5W.5%		40900	173	3
	R 085 086 087				
					6
115002	SHUNT 1.5A			173	1
	R91 (1-14-74)				259

800185 - CAP .01 MF. 250V - 153 - 1
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1200 Shames Drive, Westbury, N.Y. 11590 (516) 997-6200